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Qualitative assessment of the interest in science by high school students who participated in the Italian Masterclasses during, before and after the Covid-19 pandemic

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This study is based on a survey conducted during the International Masterclasses days taken place in almost all the Italian universities during, before, and after the Covid-19 pandemic. More than one thousand students per year mostly enrolled in scientific high schools, performed data analysis using real data collected by high energy physics experiments, about one hundred students per year familiarized with the actual operation technique used for cancer treatment employing x-rays (Particle Therapy). The survey collected the feedback given on a voluntary basis by a sub-sample of the students who participated to the 2018, 2021 (remote), and 2022 editions. Answers show a constant and significant appreciation in the activity, but also a progressive decrease of interest in physics and in technical or scientific professions or research professions in "hard" science matters. In the study presented here, the reasons of interest/disinterest in scientific fields have been investigated.

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1. Introduction

The present study refers to the International Masterclasses [1, 2] introducing Particle Physics to high school students. Around the world, several universities and research centers proposed a series of activities for young high school students showing interest in scientific subjects. The involved students used the computing centers of their closest university or worked at home using their own PC during the Covid-19 pandemic.

In particular, this study is based on feedback provided by the students who participated in the last three editions of the Italian Masterclasses.

2. The Italian Masterclasses in Particle Physics

About 1400 students per year mostly enrolled in scientific high schools, participated to the Particle Physics Italian Masterclasses. Activities based on data analysis using real data collected by high energy physics experiments (ALICE, ATLAS, Belle II, CMS, LHCb) were proposed by the Italian universities together with INFN and CNAO.

An example of the proposed exercise is the study of event displays selected from the data collected by high energy physics experiments. After some introductory class, the students were typically divided into small groups and asked to examine a set of event displays, and to identify among them events of particular interest. For example, they could find event candidates of heavy bosons (W, Z, ZZ, and also Higgs boson) and identify their decays. Some software (e.g. iSpy-WebGL for CMS [3]) were specifically designed to analyze the event displays, returning the mass of the particles associated with the reconstructed tracks of the charged particles in the detector. Analyzing the tracks, the students were asked to distinguish W^+ candidates from the W^- ones, as well as the electron decay channels to the muon ones. In this way the student could classify the events and fill histograms plotting the invariant mass of two- and four-leptons events.

Several universities proposed activities focused on Particle Therapy too. Some dedicated classes introduced the students to the role of Medical physicists in hospitals and in general of the Medical Physics research, presenting the applications at the Centro Nazionale di Adroterapia Oncologica (CNAO) of Pavia.

In addition, some universities proposed activities based on the employment of software like MatRad [4] providing simulations of the delivered dose to healthy tissue and to the tumor as a function of parameters like the irradiation angle or the kind of particles used.

3. Results of the survey

The survey performed gathers the feedback about the Italian Masterclasses activities and investigates the reasons of interest in science, as well as the factors moving part of the young people away from the world of scientific research. A sample of 213 students participated in the survey in 2018, 400 students answered to the questions at the remote edition of 2021, and 349 students participated in the survey of 2022.

Many questions have been asked, the most significant results are presented. Answers show a constant and significant appreciation in the Masterclass activities with 98% of positive rating and 70% of very positive rating.

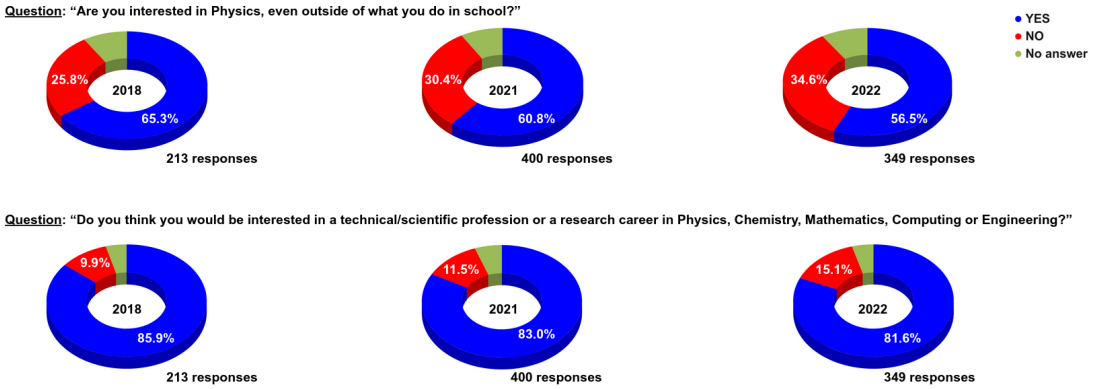

Figure 1: Survey answers concerning interest in physics at school (up) or in technical/scientific professions (down).

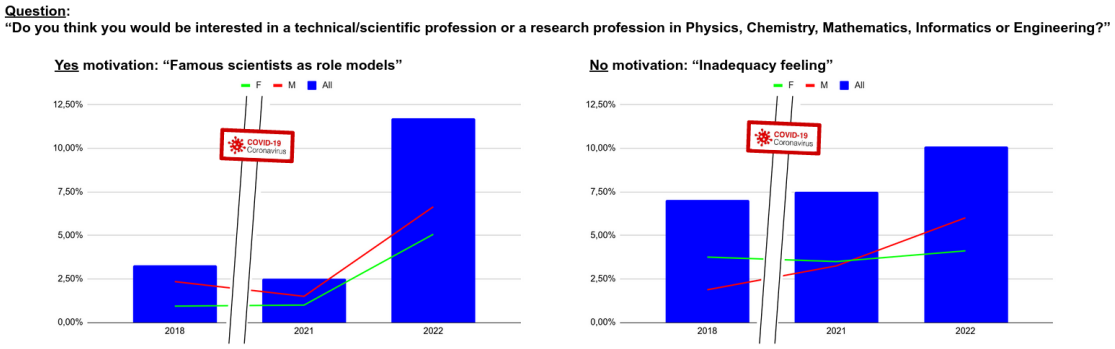

Figure 2: Examples of motivations given for interest/disinterest in scientific career. The blue histogram represents the percentage of students, over the total of the interviewed. The green and red curves correspond to the female and male components of the total, respective.

The comparison between the three different years shows a progressive decrease of interest in physics from 65.3% to 56.5% (top of Fig. 1) and a small decrease of interest in a technical or scientific profession or a research profession in science matters from 85.9% to 81.6% (bottom of Fig. 1).

Among the reasons of the negative interest in science, the feeling of inadequacy gradually increased from the 7% to the 10% of the total of the interviewed (right of Fig. 2). In particular, this trend is observed in the answers of male students. The percentage of "feeling of inadequacy" as a reason of disinterest of female students does not appear to change through the years.

On the other hand, the example of famous scientists appears to have a very positive impact on young students in this last year (2022): the percentage of the interviewed who mentioned it as a motivation of interest in science increased from the 2.5% in 2021 to the 12% of the total of the interviewed in 2022 (left of Fig. 2).

4. Conclusions

The significance of this survey is not easy to be estimated considering only about 5% of students of all the fourth and fifth grades of their institute participated on a voluntary basis at this activity.

The worry aspect of the decreased interest in physics is that the sample consists of students enrolled in scientific high schools available to follow an optional activity mainly focused on the frontiers of research in physics. The increase of the "feeling of inadequacy" as a reason of disinterest can be interpreted as an effect of the Covid-19 pandemic and all the consequences that it could have had on our society. Surprisingly, this trend is not observed in the answers of female students.

We can also observe that figures of famous scientists, like the 2021 Nobel Laureate Giorgio Parisi, appear to have had a growing impact in Italy during this last year (2022) being them known among the youngest and recognized as role model by a good part of them.

The survey shows the importance of introducing the young students to Particle Physics, and the positive role played by the Masterclasses. Their feedback provides a first overview about what we could expect from the future generations in terms of passion for the research.

References

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